





II.—*On the Cretaceous and Tertiary Floras of British Columbia and the North-West Territory.* By J. W. DAWSON, C.M.G., LL.D., F.R.S.

(Presented May 23, 1883.)

I.—GENERAL NOTES.

Collections of the Cretaceous fossil plants of Vancouver Island were made many years ago by Prof. Dana, when geologist to the United States Exploring Expedition under Commander Wilkes, and by Dr. John Evans, geologist of the Territory of Oregon. The collections of Prof. Dana were noticed by him in the report of the Expedition, and those by Dr. Evans were described by Mr. Lesquereux in the American Journal of Science for 1859. Prof. Heer, of Zurich, afterwards examined specimens from British Columbia, and in a letter to Lesquereux, and also in his memoir, entitled, "Flora of Vancouver," described and figured some of them. These botanists had in their hands, however, plants from two distinct horizons,—the Cretaceous coal measures of Vancouver Island, and Tertiary formations occurring at Bellingham Bay and elsewhere on the southern coast of the mainland of British Columbia; and as at that time such plants were not known to occur in the Cretaceous elsewhere, it was natural that they should refer the whole to the Tertiary.

In 1863 Dr. Newberry examined the collections of fossils made by the Boundary Commission in Vancouver Island, and ascertained the fact that the fossil flora of that island occurs in a formation characterized by marine Cretaceous animal remains and described the plants then in his hands as Cretaceous.

The labors of the Canadian Geological Survey since 1871 have enabled the ages of these beds and those of other parts of British Columbia to be more fully defined, and their distribution marked out. The details on these points are given in the reports of Dr. Selwyn, Mr. Richardson and Dr. G. M. Dawson for 1872 and following years. The animal fossils have also been reported on by the late Mr. Billings, and have been more fully described and figured by his successor, Mr. Whiteaves.

It is now certain that the beds containing the anthracite of the Queen Charlotte Islands with which fossil plants are associated (Series C of the general section),* are Middle Cretaceous, probably very near the horizon of the Gault, and equivalent to the upper portion of the Shasta group of the Californian geologists. The beds of the Nanaimo and Comox basins of Vancouver Island are Upper Cretaceous, and equivalent to the Chico and Tejon groups of California and to the Upper Senonien or Danien of the French. In the northern part of Vancouver Island beds of upper Neocomian age occur. These have not yet been found to hold fossil plants, but it is possible that the plant-bearing formation of Beaver Harbor is of this age.

The Queen Charlotte Island beds contain, so far as known, a strictly Mesozoic flora of Cycads and Conifers, while the Vancouver Island beds abound in leaves and wood of exo-

* See comparative Table, *infra*.

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genous and endogenous trees akin to those of the Tertiary. On the west coast a considerable gap appears to exist between the middle and upper Cretaceous, and on the east side of the Rocky Mountains, where the Cretaceous reappears and occupies a great area, the middle part, the Niobrara group of the American geologists, is almost everywhere of a strictly marine character and destitute of fossil plants. The recent researches of Dr. Selwyn and Dr. G. M. Dawson have, however, shown that toward the north, in the vicinity of Peace River, in the sediment deposited along the shore of the old Niobrara Sea, there are beds rich in fossil plants belonging to a fauna older than that of Nanaimo and intermediate between it and that of the Dakota group further south, the fossil plants of which have been so well figured and described by Lesquereux.* In the Bow and Belly River region, beds of the Pierre group, or that next following the Niobrara in ascending order, have also yielded a few fossil plants.

In our Western Territories these undoubted Cretaceous beds are overlaid by a widely spread formation, holding lignite coal and fossil plants, which has been known in Canada as the Lignite Tertiary series, and in the United States as the Laramie and Fort Union groups. Its fossil plants, as they occur in the Mackenzie River district, have been described by Heer; as they occur at the Souris River, they have been described by the writer in the Reports of the Boundary Survey and the Geological Survey. The flora of these beds is undoubtedly distinct from that of the underlying Cretaceous and of later date; but the associated animal fossils have induced many geologists to include the Laramie in the upper part of the Cretaceous, while the fossil plants are of so modern aspect that they have been held to be Miocene.

The truth appears to be that they constitute a transition from the upper part of the Cretaceous to the Eocene, and that the analogies which have been sought to be established between them and European Miocene deposits are altogether fallacious, and based on the similarity of an American flora of early Eocene date with one found in Europe at a later period. This question and the bearing of it on the so-called Miocene of Greenland and other northern regions will be discussed in the sequel.

Lastly, on the mainland of British Columbia there are ancient lake basins of Tertiary and probably Miocene age, which contain a still later flora, associated with insect remains. These beds lie below extensive volcanic accumulations in many places, and are probably contemporaneous with the Truckee Miocene of King.

The whole of the specimens collected by the Geological Survey, and representing a series of consecutive floras extending from the Lower Cretaceous to the Miocene, have been placed in my hands by Dr. Selwyn, and I have been engaged for some time in a careful study of them, now nearly completed, and some portion of the results of which I propose to state in the present paper,—referring more particularly to the plants included under the following geographical heads:—

1.—*Cretaceous of the West Coast.*

In the Middle Cretaceous of the Queen Charlotte Islands, the most characteristic plant

* Cretaceous Flora; Hayden's Geological Survey of the Territories of the United States.

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is *Cycadeocarpus* (*Diodnites*) *Columbianus*,* a species allied to the modern *Diodn edule* of Mexico, and also to species known in Europe and other parts of America as Wealden or Lower Cretaceous. With these are associated coniferous woods which indicate the existence of several species of trees allied to *Sequoia* and to *Taxus*. The somewhat limited flora of these Middle Cretaceous coal-measures of the Queen Charlotte Islands was described by me in 1873,† and as no subsequent additions have been made to it, does not need to be further noticed here.

A small collection made by Dr. G. M. Dawson at Beaver Harbor, in the north end of Vancouver Island, and not improbably of Middle Cretaceous age, though later than the anthracite of Queen Charlotte Island, contains leaves of *Salisburia* or ginkgo, and also of the genus *Neuropteris*.

A somewhat larger and more varied collection, also made by Dr. G. M. Dawson, comes from Baynes' Sound in Vancouver Island, and occurs in beds overlaid by characteristic Cretaceous marine shells. It represents an Upper Cretaceous horizon, perhaps a little lower than that of the Nanaimo coal-field. It contains several species of ferns of the genera *Teniopteris* and *Nilssonia*, and other characteristic Mesozoic genera. Associated with these in the same specimens are leaves of the modern genera, *Salix*, *Populus*, *Betula*, *Ulmus*, *Ceanothus*, *Magnolia* and *Sassafras*. There are also leaves of the curious genus *Protophyllum*, found by Lesquereux in the Cretaceous of Nebraska, and conifers of the genera *Salisburia* and *Glyptostrobus*. Baynes' Sound is in the Comox coal-basin of Vancouver Island, which, according to Mr. Richardson's sections, is approximately on the same horizon with that of Nanaimo, on the same coast.‡

The flora of Nanaimo and of Protection Island in its vicinity, has been collected by Mr. Richardson, and is proved by the animal fossils associated with it to be of Upper Cretaceous age. It holds species of ferns different from those of Baynes' Sound, and affords species of *Taxodium*, *Sequoia* and *Salisburia*, and leaves of a fan-palm (*Sabal*), and of exogenous trees of the genera *Diospyros*, *Populus*, *Juglans*, *Quercus*, and other modern types. There is also fossil exogenous wood referable to some of the same genera.

2.—Cretaceous of the North-West Territories.

In the sandstones of the Pine River and Peace River districts, not far from the base of the Rocky Mountains, and about the latitude of 54° , there have been found, in addition to ferns and species of *Sequoia* and *Glyptostrobus*, a species of *Cycadites*, and leaves of *Magnolia*, *Ficus*, *Protophyllum*, *Menispermites*, *Salix*, *Populus*, *Laurophyllum*, *Diospyros* and *Fagus*. The specimens indicate a very luxuriant and varied flora, such as might find suitable habitat on the northern shore of the great warm-water Mediterranean, which, in the Middle Cretaceous, occupied the space between the Rocky Mountains and the high lands of Eastern America. Cretaceous mollusks are associated with the plants, and one of them is identical with a species found in Queen Charlotte Islands. Coal is also associated with

* Discovered by Mr. James Richardson, and described and figured by the writer. Report Geol. Survey, 1872-3.

† Report of Geological Survey of Canada.

‡ Geological Survey of Canada, 1876-77.

these beds. Their horizon would appear to be Middle Cretaceous, and probably near to that of the marine Niobrara group of the United States geologists, which was deposited in a vast Mediterranean Sea, whose northern shore seems to be represented by the Peace River beds. This gives great importance to these plants, which fill up a portion of the gap previously existing between the flora of the Dakota group and that of the Upper Cretaceous of Vancouver Island.

A small collection made by Dr. G. M. Dawson on the Susque River, some distance to the west of the localities on the Peace River,* shows, in a highly indurated black shale, leaves of a species of *Pinus* and of a laurel.

Further to the south, and at the eastern base of the Rocky Mountains, are the coal beds of the Bow and Belly River, which are Upper Cretaceous, of the "Pierre group" age. The shales associated with these coals have as yet afforded few fossils. The most abundant is a species of *Sequoia*. Leaves of *Diodonites*, *Carpolithes*, and obscure exogenous leaves also occur.

3.—*Laramie of the North-West Territories.*

From the Laramie or Lignite Tertiary series, overlying the more typical Cretaceous, and by some geologists regarded as itself Upper Cretaceous, while regarded by others as Lower Eocene, a number of species of plants have been obtained, all, so far as known, distinct from those of the Cretaceous beds above referred to. Many of them are identical with those described by Newberry and Lesquereux from the Fort Union beds of the United States, and by Heer in his memoirs on the fossils of McKenzie River.

Some of these, collected by Dr. G. M. Dawson on the 49th parallel, I described in the Report of his Survey. Others collected by Dr. Selwyn have been described in the Report of the Geological Survey (1879-80.) A few others were recently obtained, but have not yet been catalogued or described. It is proposed to catalogue all the species determined up to this time in the sequel of this memoir.

The following table, prepared by Dr. G. M. Dawson, will serve to show the ages of the several deposits so far as yet ascertained:—

* Report Geological Survey of Canada, 1879-80, p. 104 B.

COMPARATIVE TABLE OF CRETACEOUS ROCKS.

I. England, &c.	II. Nebraska and Missouri River.	III. Rocky Mountain Region, 40th parallel.	IV. Plains between 40th Parallel and Saskatchewan. (Boundary Commis- sion Report)	V. Peace River. (Smoky River Section.)	VI. British Columbia. (Interior.)	VII. British Columbia. (Coast.)	VIII. Calif- ornia.
						Vancouver Nanaimo. Island. Comox.	
Eocene or latest Cretaceous.	Fort Union and Judith River Beds.	Laramie. 1500 to 3000.	Souris Lignite and Lignite Tertiary generally, and S. Bad Lands section. (See note *).				
Maastricht and Faxoe Beds. Denmark.	No. 6. Fox Hill 500.	Fox Hill. 1500 or more.	Division 7. Bad Lands section, also at White Mud Riv- er, Three Buttes, etc. Elbow of S. Saskatchewan, Qu- Appelle Valley, Sycamore Hill, etc.	Upper Sandstones and Shales (Wapiti Riv. group) 200 feet or more.		Sandstones 3204 Shales.... 600 1926. Productive Coal Measures 736. (See note **).	Tejon.
White Chalk.	No. 4. Pierre. 700.	Pierre 250 to 300.	Pembina Mt. Se- ries, Division 3. of Bad Lands section, also on Lower Sou- rce, Assiniboine, Qu Appelle, Elbow of S. Saskatchewan. Series R. & C. (Hector) N. Saska- chewan, West to Ft. Pitt, N. slope Cypress Hills, etc.	Upper Shales. (Smoky Riv. group) 300 feet.			Chico.
Senonian.						Queen Charlotte Islands.	
Chalk Marl.	No. 3. Niobrara. 200.	Niobrara. 100 to 200.	Limestones of Boyno and Swan Rivers, marls of Thunder Hill. Se- ries below No. 4 on E. Branch Milk River, Hector's Se- ries D. (?) on Battle River, Red Deer River, Hand Hills, etc.	Lower Sandstones. (Dunvegan Group, 100 ft. (See note †).		A. Upper Shales and Sandstones... 1500	
Upper Greensand.	No. 2. Benton. 500.	Benton. 200 to 450.	Saskatchewan at Cole's Falls. (?)	Lower Shales. Ft. St. John Group, 250 ft. or more.			
Cenomanian Gault.	No. 1. Dakota. 400. (See note ††).	Dakota. 200 to 300.	Hector's Series E. with lignites (?) Red Deer R., N. and S. Saska- chewan, etc. (?)		Neohaeo Se- ries (?) Skeena sand- stones with impure coal, Saskatchewan beds (?) Itasyouco beds, 10,000. Skeena vol- canic series. Porphyrite series. (?) Aucelle beds of Tullayoco, Jackass Mt. and Skagit- 7000 or more. Porphyrite se- ries (?)	B. Conglom- erates..... 2000 C. Lower Shales and Sandstones... 5000 (See note †††). D. Agglom- erates..... 3500 E. Lower Sandstones... 1000	Shasta.
Upper Neocomian.						Beds of For- ward Inlet, Qualino Id., Vancouver Island.	

* *Oxalis sensibilis*, *Davallia tenuifolia*, *Thuya interrupta*, *Sequoia Langsdorffii*, *Populus Richardsonii*, *Platanus nobilis*, Silicified wood, etc. (See Report on 40th parallel.)

†† *Sphenopteris elongata*, *Sabal imperialis*, *Taxodium cuneatum*, *Torreia densifolia*, *Salix pacifica*, *Populus* (several species) *Betula* *peruviana*, *Quercus Victoria*, *Diospyros Vancouverensis*, etc., etc. (See Report Canadian Survey, 1872-3.)

† *Cercidites Unio*, *Glyptostrobus gracillimus*, *Ficus maximus*, *Fagus proto-nucifera*, *Magnolia magnifica*, *Protophyllum Leconteum*, *P. boreale*, etc. (See Report of Geological Survey, 1879-80.)

††† Lesqueroux describes 130 species of plants, of which 114 are Angiosperms and are of 55 genera.

††† *Oxydendrocarpus* (*Diodontes*) *Columbianus*, *Cypripedium*, *Tuzoxylon*. (See Report of Geological Survey, 1872-3.)

It will be seen from the above table that in America the flora of the Lower Cretaceous or Neocomian retains the meagre character of the Mesozoic age, even in its upper part; but in the Cenomanian a rich Angiospermous flora was introduced and continued throughout the remainder of the Cretaceous into the Tertiary.

II.—THE MIDDLE AND UPPER CRETACEOUS FLORA.

For descriptions and figures of the plants of the Middle Cretaceous beds of the Queen Charlotte Islands, reference may be made to the Report of the Geological Survey of Canada for 1872-73. I would merely remark here that though regarded on the evidence of animal fossils as Middle Cretaceous, their fossil plants show that they must be somewhat older than the Dakota Group of the United States geologists, and therefore approaching to Lower Cretaceous. On the other hand, the beds on the Pine and Peace Rivers, explored by Dr. Selwyn and Dr. G. M. Dawson, would seem to be somewhat later than the Dakota Group, and near to the horizon of the Niobrara, in which period the greater part of the interior plain of North America was occupied with a warm-water sea, near the North-western margin of which the plants which abound in these beds must have flourished, and probably enjoyed as far north as 50° to 55°, a mild and equable climate, which may have become colder in the Upper Cretaceous period, but was again mild in the Laramie age. Both on account of the probable difference in age, and the geographical separation of the floras of the eastern base of the Rocky Mountains and of the Pacific Coast, it will be expedient to notice these separately. The first represents the flora of the interior of North America in the Lower or Middle Senonian of European geologists. The second, that of the Pacific Coast in the Upper Senonian or Lower Danian of Europe. (See table supra.)

I.—*Eastern Side of Rocky Mountains, more especially in the vicinity of the Peace and Pine Rivers.*

1. ASPLENIUM NIOBRARA, S. N. (Fig. 1.)

Frond bipinnate, small and delicate, the pinnules elongate, crenulate and with rows of oblique linear prominences, probably representing the indusia. I have referred this pretty little fern to *Asplenium*, on the evidence of the remains of fructification which it presents. The figure represents a single pinnule enlarged about four times. The specimens contain considerable portions of fronds, but imperfectly preserved.

Collected by Dr. Selwyn on the ~~Peace~~ River.

✓ ✓ 2. CYCADITES UNJIGA.* S. N. (Figs. 2, 2a.)

Midrib strong, channeled, pinnae linear, one-nerved, acute, at angle of about 50° to the midrib. Ordinary pinnae about 3 centimetres long; longest, 5 centimetres or more. Near to *C. Dicksoni*, Heer, from the Upper Cretaceous of Greenland, but petiole stouter, pinnae more acute and at more acute angle to petiole.

Collected by Dr. Selwyn at Pine River Forks, also at Table Mountain, in sandstone containing *Inoceramus altus*; also at Peace River, 25 miles above Dunvegan. (875, 1875.)

* The Indian name of the Peace River.

✓ 3. *CARPOLITHES HORRIDUS*, S. N. (Figs. 3, 3a, 3b.)

Fruit globose, 3 centimetres in diameter. Surface polished and shining, with dense thin coaly outer coat, marked with crowded pores or dots, from which are given off in a radiating manner numerous flat linear processes 4 to 5 centimetres in length, and 3 millimetres wide, and minutely dentate at their edges. I can only conjecture that this remarkable object is a compound fruit perhaps of some cycadaceous plant, covered with bracts or rudimentary leaves. Figures 3a and 3b show the processes and pores magnified.

Fig. 3b₁ represents a pinnularia-like plant found in the same bed with the last species; but whether connected with it in any way does not appear.

Collected by Dr. Selwyn, Forks of the Pine R. 1875.

✓ 4. *GLYPTOSTROBUS GRACILLIMUS*, Lesquereux, Cret. Flora, p. 52, Pt. i.

The matrix holding this species is coarse, so that the details are not very clear; but the study of a number of specimens leaves no doubt that they are identical with the species above named from Nebraska. Though placed by Lesquereux in *Glyptostrobus*, he remarks on its resemblance to *Frenelia*, and more especially to *Frenelites Reichii*, of Ettinghausen, from the Cretaceous of Neiderschaena.

Collected by Dr. Selwyn at Forks of Pine R. 1875.

✓ 5. *SEQUOIA REICHENBACHII*, Heer.

This species is represented by a few branchlets from the ^{Pine} Peace River; but further south it is found in great abundance in the roof of a coal worked on Belly River. In ironstone concretions in neighboring beds, branchlets of the same species occur, along with fossil wood of the type of that of *Sequoia gigantea*, but with more slender fibres and shorter medullary rays, and not improbably belonging to the present species. Along with it are shells of *Inoceramus*.

Collected by Dr. Selwyn, 1875 and Dr. G. M. Dawson. (Belly River, Geo. 1871.)

✓ 6. *TORREIA DICKSONIODES* S. N. (Fig. 4.)

A few leafy branches, seen in the Peace River collections, which are near to *T. Dicksonii* as described by Heer from Greenland specimens; but the leaves are more decurrent on the stem, and more obtuse. They are also very thick, and transversely wrinkled.

Collected at Pine R., by Dr. G. M. Dawson. 1879.

✓ 7. *FICUS MAXIMA*, S. N. (Fig. 5.)

Fragments of a large leaf, 8 centimetres broad and probably 24 in length, with rough surface and strongly marked veins; margin slightly crenate, narrowing abruptly to the petiole. Only the lower part of this interesting leaf is seen in the specimens collected. I refer it to *Ficus* because of the venation; but this has also some resemblance to that of *Juglans*; and more perfect specimens are required to give certainty to the reference above.

Collected at Coal Brook, by Dr. G. M. Dawson. 1879.

✓ 8. *FAGUS PROTO-NUCIFERA*. S. N. (Fig. 6, 6a.)

Leaf oval, of moderate size, pointed at base, veins straight, at angle of 35° to 40°, margin entire? Nut small, sharply mucronate, rounded triangular. This species is very near to the modern *Fagus ferruginea*, though the leaf is a little more acute at base, and may have been

entire, but this is not certain. The leaf of this species is not unlike that of the other Cretaceous beeches, as *F. polyclada*, Lesq., and *F. cretacea*, Newberry, and also resembles the *F. Antipoff* of Heer, from Sachalin Island on the coast of Siberia. This Sachalin flora is regarded by Heer as Tertiary, but it has a very Cretaceous aspect.

Collected at ~~Pace~~^{Pine} River by Dr. Selwyn. 1875.

✓ 9. *LAUROPHYLLUM DEBILE*, S. N. (Fig. 7, 7a.)

Leaf elongate, oblong, 6 to 7 centimetres long, and 2.5 broad in middle, thin and delicate, with a slender midrib, obsolete alternate veins, at angle of 40° to 50°, and dense reticulation of fine veinlets (magnified in fig. 7a); margin entire, base narrowing to petiole, apex not well seen, but probably acute.

Collected by Dr. Selwyn at Forks of ~~Pace~~^{Pine} River, and by Dr. G. M. Dawson at east branch of ~~Pace~~^{Pine} R.

✓ 10. *PROTEOIDES LONGUS*, Heer. (Fig. 8.)

Heer, Kreide Flora, p. 10, Plate 81, Fig. 5.

The venation of this leaf cannot be seen; but it is not distinguishable from the species above named.

Collected by Dr. Selwyn at Forks of ~~Pace~~^{Pine} River, by Dr. G. M. Dawson, at east branch of the same.

✓ 11. *BETULA*, Sp.

In the collections from ~~Pace~~^{Pine} River several fragments with impressions of bark having markings similar to those of the bark of the white birch tree, were found.

✓ 12. *POPULITES CYCLOPHYLLA*, Heer. (Fig. 9.)

Lesquereux, Cretaceous Flora, p. 59, plate IV.

This poplar is so near to that above named, that bearing in mind the variability of the leaves of poplars, I do not think it well to separate it. Lesquereux's specimens are from the Dakota formation in Nebraska.

Collected at ~~Pace~~^{Pine} River by Dr. Selwyn (*Pine River Cañon, Ind. 1872*.)

✓ 13. *DIOSPYROS NITIDA*, S. N. (Fig. 10.)

Closely allied to *D. anceps*, Lesquereux, but more narrow and acute, with stouter midrib and veins at angle of 40° to 45°, and less curved. Lesquereux's species seems to be different from that described by Heer in the Flora Helvetica, under the same name. Lesquereux's specimens were from the Dakota Group. Those in the present collections were obtained by Dr. Selwyn and Dr. G. M. Dawson, in the canyon of ~~Pace~~^{Pine} River.

✓ 14. *MAGNOLIA TENUIFOLIA*, Lesq.

Lesquereux, Cretaceous Flora, Page 92, Pl. XXI.

Lesquereux's specimens were from the Dakota Group. Those in the present collections were collected by Dr. Selwyn and Dr. G. M. Dawson, at Coal Brook and ~~Pace~~^{Pine} River.

✓ 15. *MAGNOLIA MAGNIFICA*, S. N. (Fig. 11.)

Leaf large, 20 centimetres or more in length. Greatest breadth, less than one half the length. Margin entire, midrib strong, in large specimens becoming broad near base. Veins

at angle of about 60°, delicate, flexuous, netting and branching toward margin. Base gradually narrowing to a wide and at first bordered petiole. Apex not seen. The smaller specimens of this leaf are not unlike those of the modern *M. acuminata*. Some of the leaves are, however, twice as large as that figured, and with the angle of venation rather less acute.

Collected by Dr. G. M. Dawson at Coal Brook. 1879

✓ 16. *MENISPERMITES RENIFORMIS*, S. N. (Fig. 12.)

Leaf broad, reniform, 11 centimetres broad and 7 centimetres in length, margins undulate. Five veined, but with two accessory veins, making 7 in all. This is a very remarkable leaf, but of somewhat uncertain affinities.

Collected by Dr. G. M. Dawson at Coal Brook.

✓ 17. *PROTOPHYLLUM LECONTEANUM*? *Lesquereux*.

Lesquereux, Cretaceous Flora, p. 103, pl. XVII.

This leaf is very imperfect, but approaches nearly in its venation to the species named.

Collected by Dr. Selwyn at Peace River, *June, 1879.*

18. *PROTOPHYLLUM BOREALE*, S. N. (Fig. 13.)

Leaf very large, rounded at base, which extends 2 to 3 centimetres beyond the attachment of the petiole. Venation based on three main ribs, springing from the midrib near its base, and which are connected with each other by veins angling upward. The lateral veins give off regular secondary veins toward the margin. The portion figured is the basal part of a large leaf, which some fragments show to have been six inches or more in its greatest diameter.

Collected by ~~Dr. Selwyn at Peace River.~~ *Dr. M. Dawson, Coal Brook, Aug 8, 1879.*

19. *PROTOPHYLLUM RUGOSUM*.

Lesquereux, Cretaceous Flora, p. 105, pl. XVII.

A leaf not very well preserved, but so far as can be seen not distinguishable from that above named, which is from the Dakota Group.

Collected by Dr. G. M. Dawson at Coal Brook. 1879.

Additional Inland Species.

20. *PINUS SUSQUAENSIS*, S. N. (Pl. III., Fig. 37.) *nearly 2 in. in breadth and 8 or more cm. in length.*

Leaves, long linear, about 3 inches in length, and 3 or more in breadth, replaced by a micaceous mineral in hard black slaty rock.

21. *LAURUS CRASSINERVIS*, S. N.

A narrow lanceolate leaf, resembling *L. Nebrascensis* of Lesquereux, but more parallel-sided and with very strong channelled midrib, having transverse wrinkles. No trace of finer venation.

Both of the above species are from the deposit in Susqua River already referred to, and believed to be of Cretaceous age.

22. *DIOONITES BOREALIS*, S. N. (Pl. III., Fig. 37.)

Petiole thick, longitudinally striate. Leaflets 16 millimetres wide, parallel-sided, decurrent at base on the petiole, longitudinally striated with about 15 striæ. Length of leaflets, 9 centimetres or more, terminations unknown.

This is a fragment of a leaf similar to that of *Dioonites Columbianus* from the Queen Charlotte Islands, but differing in size and venation. Similar leaves have been found by Fontaine in the Lower Cretaceous of Virginia, and in Europe they are considered to be characteristic of the Lower Cretaceous. In America, however, *Dioon edule* still survives as a representative of this type of cycads.

Collected by Mr. R. G. McConnell, on Willow Creek, N. W. Territory.

2.—Upper Cretaceous of Vancouver Island.

✓ 1. *NEUROPTERIS CASTOR*, S. N. (Fig. 14, 14a.)

Pinnules at right angles to rhachis, closely set, oblong, abruptly pointed, attached by whole base. Midrib strong, fading before reaching the point. Veins obscure, but apparently at an acute angle to the midrib. Very abundant at Beaver Harbour.

Collected by Dr. G. M. Dawson. 1878.

✓ 2. *TENIOPTERIS PLUMOSA*, S. N. (Fig. 15.)

Resembles closely *T. Vittata* and *T. Gibbsii* of Newberry, but has the veins forming an angle of 50° with the midrib, which is very strong, giving off to the even margin strongly marked parallel veins. Breadth 2 centimetres; length and termination unknown.

Collected by Dr. G. M. Dawson at Baynes' Sound. 1878.

✓ 3. *NILESONIA LATA*, S. N. (Figs. 15, bis. 15 a.)

Frond at least 6 centimetres broad. Pinnules about 1.2 centimetres in breadth, each with about 30 parallel veins at angle of 50° from the rib. Pinnæ separated from each other by narrow acute lacunæ. Midrib broad and channeled. Terminal pinna a little broader than the lateral segments.

Collected by Dr. G. M. Dawson at Baynes' Sound. 1878.

✓ 4. *PTERIS (OLEANDRA) GLOSSOPTEROIDES*, S. N. (Fig. 16.)

Pinna lanceolate, 2 centimetres wide, 8 or more long. Midrib strong, giving off ascending curved twice-forking veins, which from their flexuous character sometimes appear netted. Margin of pinna apparently inflexed or thickened. Resembles *Oleandra arctica*, Heer, from Greenland; but has the veins at a more acute angle.

Collected by Mr. J. Richardson, at Protection Island. 1873.

✓ 5. *SPHENOPTERIS ELONGATA*, Newberry. (Figs. 17, 17 a.) Newberry, Boston Journal of Natural History, Vol. VII., No. 4.

This species was described by Newberry, from specimens collected at Orcas Island, on the Coast of Oregon. It is compared by him with *S. Verletii*, Brngt. It is doubtfully referred to *Sphenopteris*, but as the fructification is unknown, may be allowed to remain there at present.

Collected by Mr. J. Richardson, at Protection Island. 1873.

✓ 6. *DAVALLITES RICHARDSONI*, S. N. (Figs. 18, 18 a, 18 b.)

Barren pinnæ, nearly at right angles to the petiole; narrow, with oboval pinnules, united at base, few veined and slightly decurrent on the partial petiole, to which they are at right angles. Length of pinnæ 5 millimetres or less. Terminal pinna obtuse, lobed. Fertile pinnæ much narrower with semilunar pinnules, each with two thecæ on the upper edge.

Collected by Mr. J. Richardson, at Protection Island. 1873.

✓ 7. *ADIANTITES PRÆLONGUS*, S. N. (Fig. 19.)

Frond simple, widening gradually from the base to near the apex, which is truncate and sometimes lobed. Length 10 centimetres, breadth about 3 centimetres. Texture apparently thin and delicate. Veins slender, diverging at very acute angles, and forking several times. This is evidently a fern, but of doubtful affinities.

Collected by Dr. G. M. Dawson at Baynes' Sound. 1878.

✓ 8. *PECOPTERIS*, S. N.

Tri-pinnate, with small closely placed pinnules, bluntly pointed. Venation obscure.

Collected at Baynes' Sound, by G. M. Dawson. 1878.

9. *ASPIDIUM KENNERLII*, Newberry, Boston Journal of Natural History, Vol. VII, No. 4.

This fern, said by Newberry to be very abundant in the shales over the Newcastle coal at Nanaimo, appears only in a few fragments in the collections submitted to me.

✓ 10. *TORREIA DENSIFOLIA*, S. N. (Fig. 20, 20 a.)

Branchlets with crowded leaves, which are about 2 centimetres long and 4 millimetres in breadth, obtusely pointed, parallel-sided and decurrent on the branchlets; one-veined, thick. In the absence of any knowledge of its fruit, the reference of this very distinct and beautiful plant is of course very uncertain.

Collected by Mr. J. Richardson, at Protection Island. 1873.

✓ 11. *GLYPTOSTROBUS*, S. N.

Fragments of branchlets resembling *G. Europæus* in size and form, but too obscure for certain determination.

Collected by Dr. G. M. Dawson, at Baynes' Sound. 1878.

✓ 12. *TAXODIUM CUNEATUM*, Newberry, Boston Journal of Natural History, Vol. VIII, No. 4.

Newberry describes this as follows: Leaves numerous, short, broad-spatulate in form, rounded or sub-acute at summit, narrowed into a very short petiole or sessile on the branchlets.

Collected by Mr. J. Richardson, at Nanaimo and Protection Island. 1873 (Newcastle 74'2)

✓ 13. *SALISEURIA BAYNESIANA*, S. N. (Figs. 21 and 21 a.)

Leaf obliquely cuneate, thick; nervation dichotomous, obscure. Margin entire at sides, sinuate at apex. Leaves of *Salsburya*, possibly of the same species, though somewhat larger, are found at Beaver Harbour, and are associated with oval seeds or nutlets possibly of the same tree.

Collected by Dr. G. M. Dawson, at Baynes' Sound and Beaver Harbor. 1878, 1878.

✓ 14. PHRAGMITES CORDATIFORMIS, S. N. (Fig. 22.)

An inch or more in width when full grown. Parallel veins distant from each other at out 5 millimetres, and with some intervening striæ. Resembles *P. Cretaceous*, Lesq., from Nebraska, but differs in venation. To the naked eye this leaf very closely resembles *Cordaites borassifolia* of the coal formation.

Collected by Mr. James Richardson, at North Saanich and Nanaimo, and by Dr. G. M. Dawson, at Baynes' Sound. 1875, 1876, 1878.

✓ 15. SABAL IMPERIALIS, S. N. (Fig. 23.)

Sabal, Sp., Newberry, Boston Journal, Vol. VII., No. 4.

Midrib elongate; more than 16 centimetres long and 1.8 wide; coarsely striate longitudinally, perhaps in consequence of pressure. Leaf having folds varying from 8 to 15 millimetres in breadth, at angle of 55° to 60° at base, more acute upward. Nerves fine, 30 to 60 on each fold, five or six on each side of the middle being coarser than the others. General form and margin unknown, but must have been one to two feet or more in diameter of blade. This is undoubtedly the *Sabal* mentioned by Lesquereux and Newberry, as found in fragments in collections from Nanaimo. At the Harwood colliery, ~~on that island~~ Mr. Richardson obtained large leaves, but on a shale so brittle and jointed that it was impossible to secure them entire.

Nanaimo,

✓ 16. SALIX PACIFICA, S. N. (Fig. 24.)

Leaf elongate, pointed at both ends. Apex somewhat abrupt, base oblique. Length 8.5 centimetres, breadth in middle 1.3 centimetres. Midrib conspicuous; margin entire. In one specimen a group of leaves appears attached to a slender twig.

Collected by Dr. G. M. Dawson, at Baynes' Sound.

17. POPULUS RHOMBOIDEA, Lesqr.

Lesquereux. American Journal of Science, Vol. XXVII, p. 360.

Originally described by Lesquereux from specimens collected by Dr. John Evans at Nanaimo. Was described as "rhomboidal, with the margin irregularly toothed above and entire near the slightly decurrent base. Lateral primary veins diverging at an acute angle like the secondary ones, and ascending to both corners of the rhomb of the leaf, all strongly marked with scarcely visible percurrent veinlets." It is a leaf with the venation on the same plan with that of the modern *P. grandidentata*.

Collected by Mr. J. Richardson, at Newcastle Island.

✓ 18. POPULUS PROTOZADACHII, S. N. (Fig. 25.)

Closely allied to *P. Zadachii*, of Heer, in its style of venation and crenated margin, but with fewer and more delicate veins and broader form.

Collected by Mr. J. Richardson, at Newcastle Island. 1873.

✓ 19. POPULUS TRINERVIS, S. N.

A poplar-like leaf, with three slender veins forking upwards. Very peculiar and distinctive, and represented by several specimens but all imperfect at the margins.

Collected at Nanaimo by Mr. James Richardson, and at Baynes' Sound by Dr. G. M. Dawson.

✓ 20. *POPULUS RECTINERVATA*, S. N. (Fig. 26.)

Leaf large, with entire margin, or only a few distant obsolete teeth, general form apparently broad oval or ovate. Midrib delicate; veins slightly curved, diverging from the midrib at an angle of about 25° , so that they appear very erect and approximately parallel to each other, forking twice before they reach the margin. Resembles in venation large and luxuriant leaves of *P. balsamifera* and also the *P. mutabilis* of Heer.

Collected by Dr. G. M. Dawson, at Baynes' Sound. 1878.

✓ 21. *POPULUS LONGIOR*, S. N.

Plan of venation similar to the last, but veins at a still more acute angle and the form of the leaf narrower and with entire margin.

Collected by J. Richardson, at Harwood colliery, Nanaimo; by Dr. G. M. Dawson, at Baynes' Sound. 1875, 1878.

22. *POPULUS*, Sp.

This is a very large poplar leaf which must have been four inches in breadth. It has a venation similar to that of *P. grandidentata*, but the teeth of the margin much smaller. The specimens are in fragments.

Collected by Dr. G. M. Dawson, at Baynes' Sound.

It should be noted that, in accordance with the numerous poplar leaves found in these beds, wood, having the structure of modern poplar, is by no means uncommon in the same formations.

✓ 23. *BETULA PERANTIQUA*, S. N. (Fig. 27).

Ovate, elongate, veins at angle of about 50° , with midrib slightly curved and beginning to fork toward margin, which is entire, or with only very shallow teeth. Leaf, acute at apex; less acute at base. Length of ordinary specimens, 5.5 centimetres. Breadth, ~~2.5~~ 2 (two) centimetres. Six veins on each side.

Collected by Dr. G. M. Dawson, at Baynes' Sound. 1878.

✓ 24. *QUERCUS VICTORIAE*, S. N. (Fig. 28).

Leaf, large, probably 4 to 5 inches long; broadly lanceolate, slightly toothed at margin. Veins nearly straight, at angle of 45° , and about 0.7 centimetre apart. Approaches somewhat to *Q. multinervis* of Lesquereux, but differs in angle of venation.

Collected by Mr. J. Richardson, at Newcastle Island, Nanaimo River and Protection Island. 1878, 1879.

✓ 25. *ULMUS DUBIA*, S. N. (Fig. 29).

A fragment of a leaf with the venation of *Ulmus*. Veins nearly opposite, at angle of about 40° ; curved and forking toward margin, which has distant teeth. Veinlets coarsely reticulated, with a tendency to transverse arrangement. A few imperfect interstitial veins. Leaf curved, and apparently dry and harsh. Breadth, 2.6 centimetres, apparently somewhat oblique at base.

Collected by Dr. G. M. Dawson, at Baynes' Sound. 1878.

✓ 26. *SASSAFRAS*, Sp. (Fig. 30, 30 a).

A small cuneate leaf, apparently trilobed at summit, and with three slender veins,

diverging at a very acute angle from the base. Usual length, about 5 centimetres. Leaves of this type are found at Baynes' Sound and Vancouver Island; but too imperfectly preserved to admit of any certain distinction from described species.

27. *JUGLANS HARWOODENSIS*, S. N. (Fig. 31).

Leaf ovate, narrowing toward the base. Midrib distinct; veins at a very obtuse angle, nearly 80°, curving and netting at margin, which seems to be slightly toothed. Breadth, 4 centimetres; length, probably 11 centimetres.

Collected by Mr. J. Richardson, at Harwood Colliery, Nanaimo. 1878;

28. *DIOSPYROS VANCOUVERENSIS*, S. N. (Fig. 32).

Oval, pointed at base, obtuse and oblique at apex. Margin, entire or slightly undulate. Midrib and veins strongly marked; angle of divergence of veins from midrib, about 60°. Veins curved strongly and uniting at the margin. Veinlets transverse, straight, giving a coarse rectangular reticulation. Length, about 5.5 centimetres; breadth, 3 centimetres.

Collected by Mr. J. Richardson, at Nanaimo. *Nan. Review* 2^d m. vol. - 7. 1873.

29. *CEANOTHUS CRETACEUS*, S. N. (Fig. 33).

Regularly elliptical with three principal veins, the lateral ones curving regularly from base to apex. Margin, crenulate. Minor venation, obscure. Length, 5 centimetres; breadth in middle, 2.6. Distance of lateral veins from midrib in middle, 0.8 centimetre. The modern *C. Americanus* has very similar leaves, but broader in proportion. *C. ovalis* has narrower leaves. This ancient leaf is thus between the two. This leaf might be included in the genus *Cinnamomum*, as defined by fossil botanists; but I cannot distinguish it from the foliage of the modern genus *Ceanothus*, still living in the west.

Collected by Dr. G. M. Dawson, at Baynes' Sound. 1878.

30. *ANISOPHYLLUM*, Sp. (Fig. 34).

Apparently a soft, fleshy leaf, with strong midrib, and giving off a large branching vein at one side near the base, and more slender and simple veins elsewhere. Length, about 7 centimetres; breadth, about 4. Margin, entire.

Collected by Dr. G. M. Dawson, at Baynes' Sound. 1878.

31. *PROTOPHYLLUM NANAIMO*, S. N. (Fig. 35).

Large, 16 centimetres or more long, and 12 in breadth. Veins very nearly opposite, and at an angle of 55° to the midrib. Interspaces with transverse veinlets more or less netted and curved, or angled upward. Approaches to *P. leconteanum* of Lesquereux, from the Dakota group.

Collected at Nanaimo by Mr. J. Richardson; at Baynes' Sound, by Dr. G. M. Dawson. 1878.

32. *ALNITES INSIGNIS*, S. N. (Pl. viii., Fig. 44.) 34/

Leaf coriaceous, shining, somewhat triangular or broad cuneate, rounded and coarsely toothed above; smaller and distant teeth on the sides; narrow at base and rapidly widening. Midrib straight, well marked, veins about equally strong, very slightly curved, diverging from the midrib at an angle of 50° and running direct to margin, nearly parallel to each other. Veinlets straight, simple, at right angles to the veins. Lateral margins,

outside lowest veins, narrow, with a few veinlets at acute angles running to the teeth. In the figure one side of the leaf appears less curved than natural, owing to a slight fold in the specimen.

This leaf is very puzzling in its structure, and up to the time of writing out my paper for the press, I had seen only fragments of it. I have, however, been able at length to uncover a nearly perfect specimen in shale from Nanaimo, from which the above description is taken. The form and venation recall features of the genera *Alnus* and *Platanus*; but I have seen no leaf, recent or fossil, which it entirely resembles. *Nanaimo, J.R., 1875.*

✓ 33. CARPOLITHES, Sp.

Small, round, smooth fruits or seeds, also ovate seeds, and ovate seeds with a rib on one side, are found at Beaver Harbor and Baynes' Sound. They may be seeds of taxine trees.

Miscellaneous and Undetermined.

In the collections from Vancouver Island, there are many other kinds of leaves, referable to the genera *Quercus*, *Diospyros*, *Magnolia*, &c., which are too imperfect for description, and there can be no doubt that the species above described, constitute but a fraction of a rich and varied flora which might, no doubt, be in great part restored by active and judicious collecting, pursued by observers having more time at command than those who have collected in these beds.

III.—THE LARAMIE AND TERTIARY FLORAS.

The whole of the plants classed under the last head belong to undoubted Cretaceous beds, characterized as such by animal fossils, and by stratigraphical position. It is true that the Coal-measures of Vancouver Island have been regarded as Miocene by the earlier observers; but this was solely on account of the supposed Tertiary character of their flora. The more detailed explorations of the Geological Survey of Canada have fully established their relation with the beds holding *Inoceramus*, *Baculites*, and other Cretaceous forms. Some portion of the confusion regarding these beds arose from the mixture of their fossils with those of the Tertiary beds. For example, in Heer's Memoir on the "Flora of Vancouver Island and British Columbia," the greater part of the species described are from the Tertiary deposits of Burrard Inlet and Bellingham Bay, on the island.

Both in British Columbia, however, and east of the Rocky Mountains, the Cretaceous proper is overlaid by newer beds. West of the Rocky Mountains these assume the form of old lake basins, filled with fresh-water deposits holding remains of plants and insects, which have been noticed or described in the reports of the Geological Survey of Canada, and are undoubtedly Tertiary, probably Miocene.* East of the mountains, on the other hand, the undoubted Cretaceous beds of the Fort Pierre and Fox Hill groups are covered conformably by a widely extended series of clays and sandstones, holding fossil plants and lignite, with brackish-water and fresh-water shells. This is known as the Laramie.

*Reports of Geological Survey, 1875-6, 1876-7, 1877-8.

review

Lignitic or Fort Union Group. To this belong the plants from Porcupine Creek and the Souris River described by the writer in Dr. G. M. Dawson's Report on the 49th Parallel, and in the Reports of the Geological Survey of Canada,* the plants described by Heer from Mackenzie River,† and those of the Fort Union beds of the Upper Missouri described by Newberry and others. They constitute also the Lower Tertiary or Lignitic Flora of Lesquereux.‡

With reference to the age of the Laramie beds, considerable diversity of opinion has prevailed, and I do not purpose here to ~~review~~ the discussions which have taken place; but merely to state what seem to be well ascertained facts. These are as follows:—

1. The Laramie beds pass downward into the undoubted Upper Cretaceous, without any stratigraphical break.
2. Their invertebrate fossils being largely fresh-water and estuarine and partly of Cretaceous, and partly of Lower Tertiary types, do not give very precise indications of age, but the beds hold reptilian remains of genera usually held to be Mesozoic, while no mammalian remains have yet been found.
3. According to the observations of the United States geologists, the Laramie beds are known to underlie, in some places conformably, and in others unconformably, the Wahsatch series, which is regarded as Middle Eocene.
4. The flora is distinct on the one hand from that of the Cretaceous below, and on the other from that of the undoubted Miocene of British Columbia and the South-Western States.
5. The Laramie Group has been subdivided on stratigraphical grounds into four sections, but no grounds are known which would warrant its division into distinct formations.

Clarence King, in his Geology of the 40th Parallel, places the Laramie in the Cretaceous, on the evidence, more especially, of its vertebrate remains. Puzzled, however, by the confident assertions as to the Miocene aspect of certain fossil plants, he seems to suspect that in the Fort Union series there may be a confusion of the Tertiary beds with the Cretaceous. He places, however, without hesitation in the Eocene the Green River group, whose plants are placed by Lesquereux with the Miocene. White, the Palaeontologist of the United States Survey of the Territories, approaches to the same general view when he says in his report of 1880, that the Laramie is "a transitional group between the Cretaceous beneath and the Tertiary above."§ This was the opinion expressed by the writer, with reference to the Canadian development of the Laramie, in the Report of the Boundary Commission in 1875; and more recently in a note on Fossil Plants collected by Dr. Selwyn.||

But though I believe no American geologist or palaeontologist would now hold these beds to be newer than the oldest Tertiary, I observe that Heer, in a note on the fossil

* 1870-80.

† Flora Fossils Arctica.

‡ Tertiary Flora, Geological Survey of the Territories of the U. S.

§ See also papers by Prof. Stevenson in Am. Journal of Science, and in Report of Wheeler's Survey, 1881.

|| Report of Geol. Survey of Canada, 1879-80.

plants of Mackenzie River, published as late as June, 1880,* still regards them as Miocene. As the opinions of a palaeobotanist so eminent deserve careful attention, it may be well to examine the reasons which he gives.

1. He affirms that none of the species occur in the Eocene of Europe. But the Eocene of Europe presents features distinct from those of any American Tertiary Flora, and depending evidently on peculiar geographical conditions. Further, Gairdner and others hold that Heer unduly limits the European Eocene; and if their views were established, the statement made by Heer would fall to the ground.

2. Several of the plants are common to the Laramie beds and to the so-called Miocene of Saghalien, of Alaska, and of Greenland. With respect to the former, there is reason to suspect that the Saghalien flora, as described by Heer, may be Cretaceous. It has many points in common with the Flora of Nanaimo, and it occurs in beds resting immediately on deposits holding Cretaceous animal remains. The Alaska and Greenland floras have not been proved to be Miocene, and as the Greenland flora succeeds the Cretaceous without the intervention of any other flora, it is not improbably really Eocene.

3. The Mackenzie River beds present few points of identity with those of the American Eocene; but in making this comparison Heer classes as Miocene the Green River and Fort Union beds, which may be representatives of the beds in question, but which all American geologists regard as Eocene, or older. He can thus only compare the Laramie group with that portion of the older Tertiary admitted by Lesquereux as Eocene, while the other Eocene or later Cretaceous beds of the adjoining parts of the United States, are left out of the comparison, being, like the Canadian Laramie, arbitrarily relegated to the Miocene.

The following tabular view will serve to show the actual difference between Heer and the geologists of the United States and Canada with reference to the Laramie beds:—

Eocene and Cretaceous beds, as given in Clarence King's Report on the 40th Parallel.

<i>Eocene.</i> —Uinta Series.	<i>Cretaceous.</i> —Laramie?
Bridger Series.	Fox Hill.
Green River Series.	Colorado.
Vermillion Creek (Coryphodon beds).	Dakota.

According to Lesquereux, the Green River beds of the above list are Upper Miocene, the Vermillion beds are Lower Miocene, and the Laramie are Eocene. But according to Heer even the Laramie, or a large portion of it, is Miocene. The actual origin of this error is the continuance of similar Floras in America from the Middle Cretaceous up to the modern time, while much greater changes have occurred in Europe within the same great periods.

* Proceedings Royal Society of London.

List of Laramie Plants from the North-West Territories of Canada.

Those marked with an asterisk are known in beds of similar age in the United States.

- | | |
|--|--|
| * <i>Onoclea sensibilis</i> , L. | <i>C. Americana</i> , Walt. |
| <i>Davallia</i> (<i>Stenoloma</i>) <i>tenuifolia</i> , Swin. | † * <i>Platanus nobilis</i> , N'by. |
| <i>Equisetum</i> , Sp. | <i>P. heterophyllum</i> , N'by. |
| <i>Physagenia Parlatorii</i> , Heer. | <i>Diospyros</i> , Sp. |
| ✧ * <i>Glyptostrobus europæus</i> , Heer. | * <i>Sapindus affinis</i> , N'by. |
| ✧ * <i>Sequoia Langsdorffii</i> , Heer. | † <i>Rhamnus</i> , Sp. |
| * <i>Thuja interrupta</i> , Newb. | * <i>R. Concinnus</i> , N'by. |
| ✧ * <i>Taxites Olriki</i> , Heer. | † * <i>Carya antiquorum</i> , N'by. |
| ✧ * <i>Taxites occidentalis</i> , N'by. | † * <i>Juglans cinerea</i> ? |
| <i>Lemna scutata</i> , D'n. | † * <i>Sassafras Selwynii</i> , D'n. |
| <i>Phragmites</i> , Sp. | * <i>Viburnum pubescens</i> , Pursh. |
| <i>Scirpus</i> , Sp. | <i>Viburnum Lakesii</i> , Lesqr. |
| ✧ * <i>Populus arctica</i> , Heer. | <i>Ficus tiliæfolia</i> (or allied) Brongt. |
| * <i>P. acerifolia</i> , N'by. | <i>F.</i> allied to <i>F. spectabilis</i> , Lesqr. |
| ✧ * <i>P. cuneata</i> , N'by. | <i>Quercus</i> , Sp. allied to <i>Q. antiqua</i> , N'by. |
| ✧ <i>P. Hookeri</i> , Heer. | <i>Aesculus antiqua</i> , D'n. |
| ✧ <i>P. Richardsonsii</i> , Heer. | <i>Trapa borealis</i> , Heer. |
| <i>Salix Racana</i> , Heer. | ✧ <i>Carpolithes</i> , Sp. |
| ? ✧ * <i>Corylus rostrata</i> , Ait. | |

The following fossil woods are associated with the above :—

Populus, several species.

Juglans.—The structure is well preserved, and not distinguishable from that of wood of

Juglans cinerea, leaves of a species resembling, which also occur, as noted above.

Cedroxylon, Sp. Possibly the wood of *Thuja interrupta*.

Pitoxylon, Sp.

Cupressoxylon, Sp.

(a) allied to wood of *Sequoia sempervirens*.*

(b) " " *S. gigantea*.

(c) possibly wood of *Glyptostrobus*,

Three other species.

Taxoxylon, Sp.

Coniferous woods of the above types also occur abundantly in the Lignites, and can be made out when these are treated with caustic potash.

The following are the species recognized by Heer, in the collections from Mackenzie River, studied by him :—

Xylomites borealis, Heer (growing on leaves). *Quercus Olafseni*, Heer.

Glyptostrobus Ungerii, Hr.

Platanus aceroides, Hr.

✧ *Sequoia Langsdorffii*, Brongt.

Juglans acuminata, Brongt.

* Probably the wood described by Schroeter, in Heer's *Flora Arctica*, as *Sequoia Canadensis*.

† <i>Taxodium distichum</i> , (Miocenum.)	<i>Viburnum Nordenskiöldii</i> , Hr.
<i>Smilax Franklini</i> .	<i>Pterospermites spectabilis</i> , Hr.
* <i>Populus arctica</i> , Hr.	<i>Pt. dentatus</i> , Hr.
* <i>P. Richardsoni</i> , Hr.	<i>Tilia Malgreni</i> , Hr.
* <i>P. Hookeri</i> , Hr.	<i>Phyllites aceroides</i> , Hr.
<i>Salix Raeana</i> , Hr.	<i>Carpolithes Seminulum</i> , Hr.
* <i>Betula macrophylla</i> , Gpt.	<i>Hedera MacClurei</i> , Hr.
<i>Corylus McQuarrii</i> , Forbes.	<i>Magnolia Nordenskiöldii</i> , Hr.

The only species common to the Mackenzie River beds and those further south, are those marked with an asterisk, but I believe that further comparison would increase the number of identical species. This I have not had time or opportunity to institute, since the receipt of Heer's last memoir. I feel convinced, however, that the differences in species in the different localities of the Laramie, are caused largely by difference of station, and are increased by the different views taken by observers as to the generic affinities of leaves, and by description of mere varieties as distinct species. The poplars are especially open to this remark. The genus *Populus* seems to have been dominant over wide areas of the west from the later Cretaceous to the present time; and large quantities of material are available which will be of great value in determining horizons; but at present the confusion of nomenclature of European and American authors is so great, that a thorough revision of the whole series seems to be required.

Tertiary Plants from the Interior of British Columbia.

I have referred above to these plants as occurring in deposits probably lacustrine and of later age than the Laramie of the plains. They may be of the same age with those of Burrard's Inlet, noticed by Heer in his memoir on Vancouver plants, and with those of the Alaska and Bellingham Bay beds, described by Heer and Newberry, and with those described by Lesquereux, from some of the Tertiary deposits of the western territories of the United States, which have been referred to the Miocene period.

I.—Quesnel and Blackwater Rivers :—*

The plants from these places are contained in white lacustrine silt and brown ferruginous sandstone. They include leaves of *Acer*, *Juglans*, *Carya*, *Castanea*, *Quercus*, *Fagus*, *Platanus*, *Betula*, *Rhamnus*, *Diospyros*, *Taxodium* and *Sequoia*, along with many nuts and fruits probably belonging to the same species with some of the leaves. None of these species, except the *Sequoia*, seem to be identical with any from the Laramie or Cretaceous; but several are the same with American and European species regarded as Miocene. This flora is very rich, especially in fruits, and it is greatly to be desired that more extensive collections should be made in it. The Quesnel beds have afforded a number of species of insects which have been described by Dr. Scudder, and are regarded by him as Tertiary.†

* G. M. Dawson, Report Geological Survey of Canada, 1875-6, 1877-8.

† G. M. Dawson, l. c.

II.—*Similkameen River**:—

The plants from this place are in a brownish shale, abounding in fragments of a large *Equisetum*, which I have described in the report cited under the name of *E. Similkamense*. With this are numerous leaves of *Populus Arctica*, Heer, and a few of *P. latior*; and also species of *Carpinus*, *Platanus*, *Nelumbium*, *Sapindus*, *Myrica*, *Betula*, *Paliurus*, *Vaccinium*, *Taxodium*, *Sequoia* and *Glyptostrobus*, and a fragment of *Thuja*, not distinguishable from *T. occidentalis*. The species are different from those found at Quesnel, but like them apparently of Middle Tertiary age.

III.—*Reserve, North Thompson*†:—

The leaves from this place, in a matrix of grey arenaceous shale, are almost exclusively poplars, referable to *Populus Arctica*, *P. Genetrix*, Newberry, and another species. With these is a species of *Rhus*, allied to *R. roseifolia* of Lesquereux.

When the plants from these localities shall have been fully collected and studied, it will be time to offer opinions as to the precise horizons of the Tertiary which they represent. With so small collections from only a few localities, the local differences are likely, to some extent, to mask those depending on age. There can be no doubt, however, that they belong to the Tertiary period, and that they may be somewhat newer than the Laramie deposits of the plains. Like these they are associated with Lignite, and when this shall be worked we may expect that larger collections will be available.

* G. M. Dawson, Report Geological Survey of Canada, 1877-8, p. 186 B.

† G. M. Dawson, l. c.

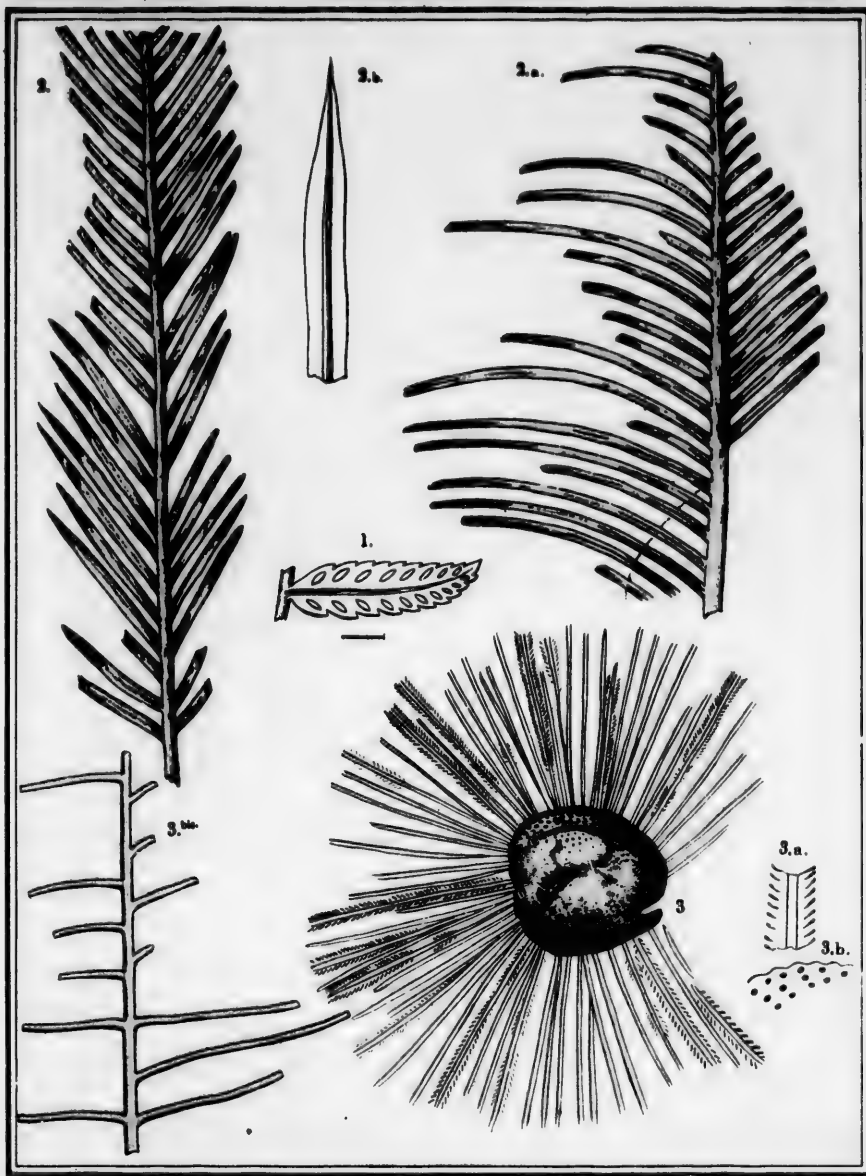


Fig. 1. *Asplenium Niobrara*. 2. *Cycadites Unjiga*. 3. *Carpolithes horridus*. 3.b. *Pinnularia*.

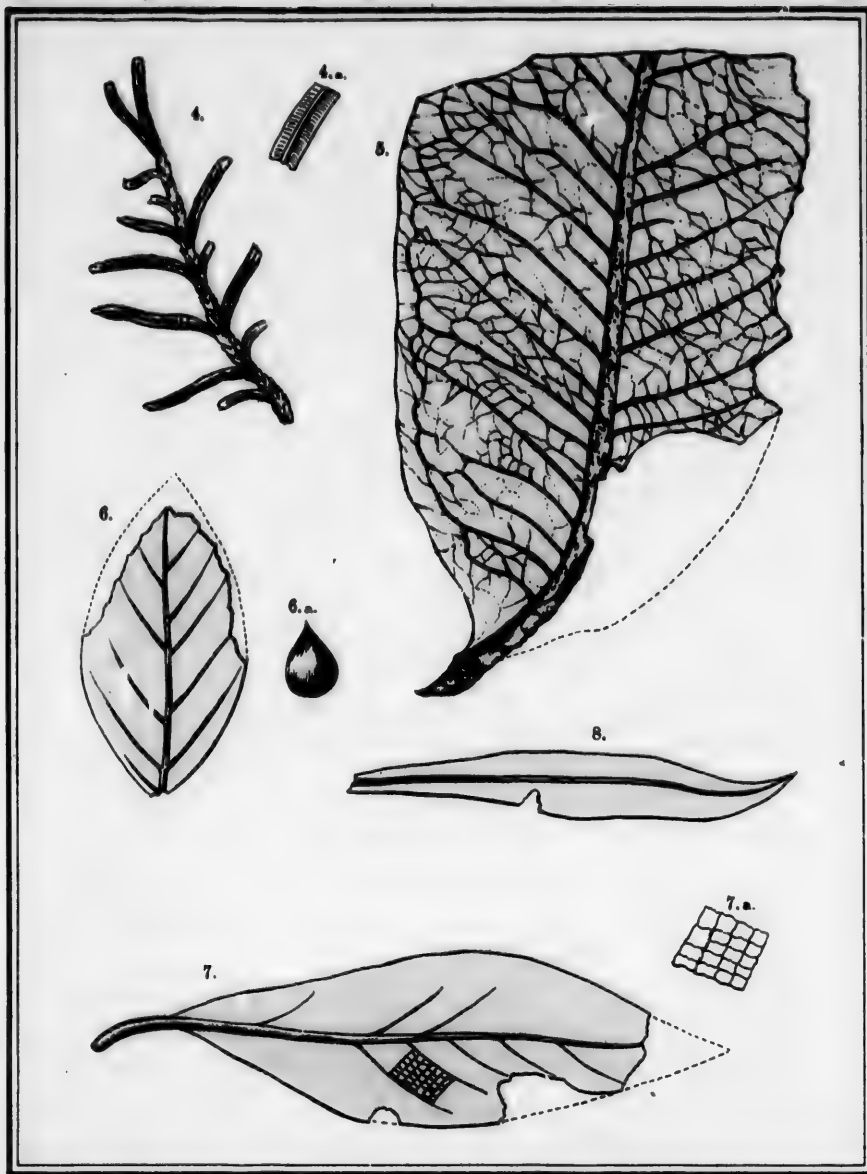


Fig. 4. *Torreya dicksonioides*. 5. *Ficus maxima*. 6. *Fagus proto-nucifera*.
7. *Laurophyllum debile*. 8. *Proteoides longa*.

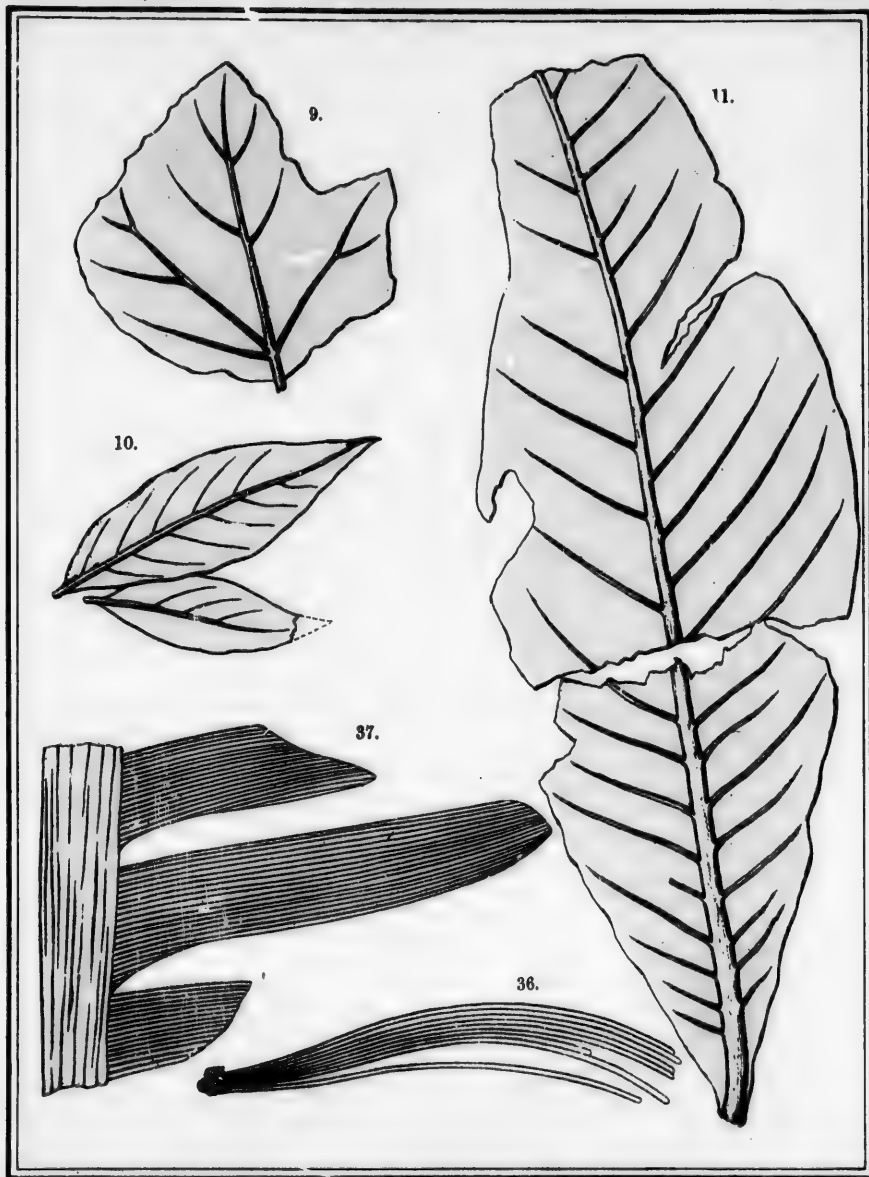


Fig. 9. *Populus cyclophylla*. 10. *Diospyros nitida*. 11. *Magnolia magnifica*.
36. *Pinus Suskwaensis*. 37. *Dioonites borealis*.

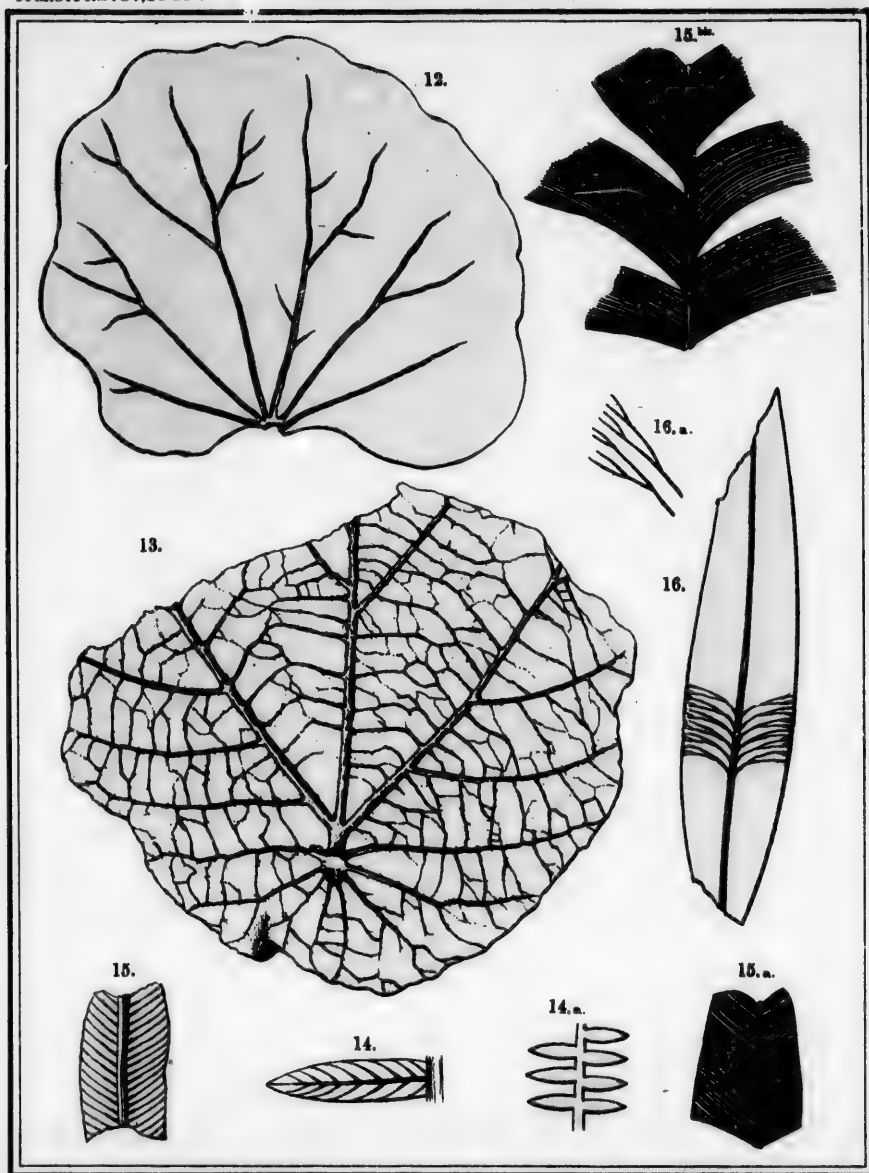


Fig. 12. *Menispermites reniformis*. 13. *Protophyllum boreale*. 14. *Neuropteris curta*.
 15.^{bis}. *Nilssonia lata*. 15. *Taeniopteris*. 16. *Pteris glossopteroides*.

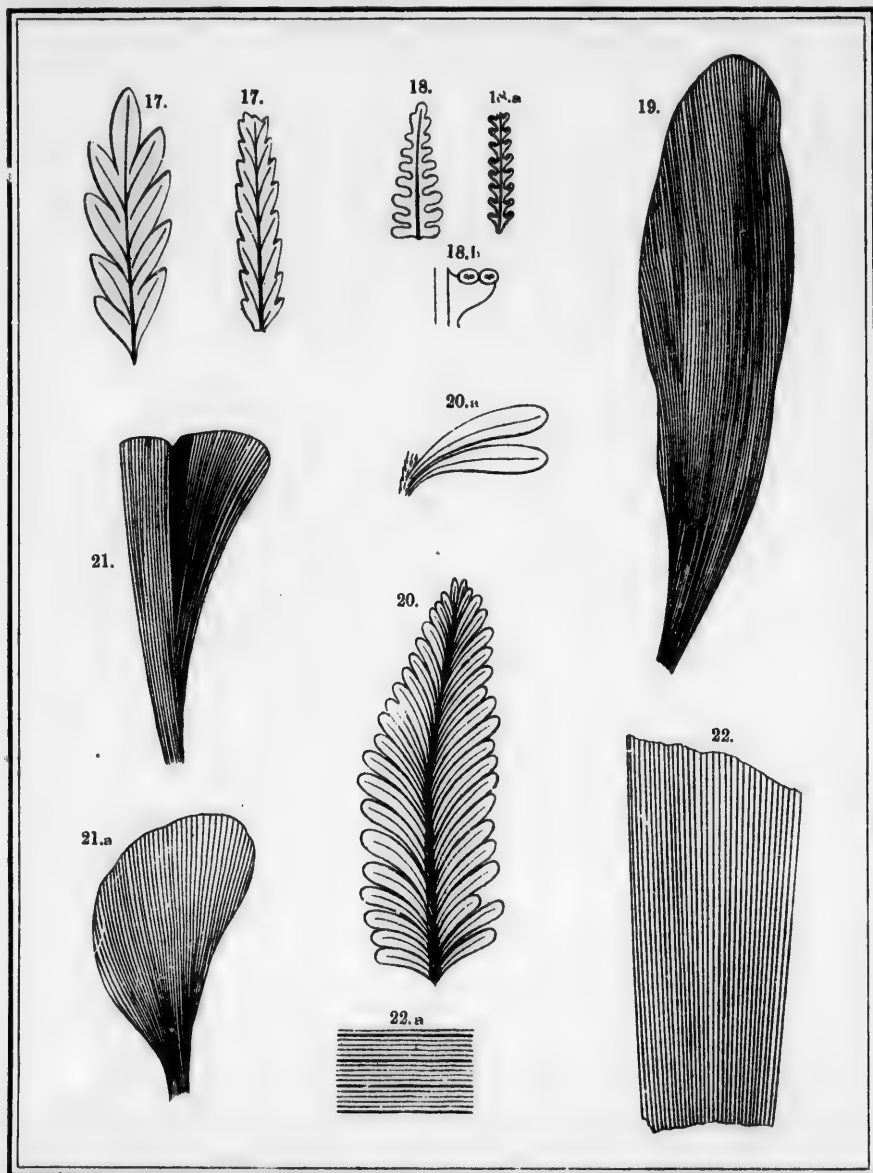
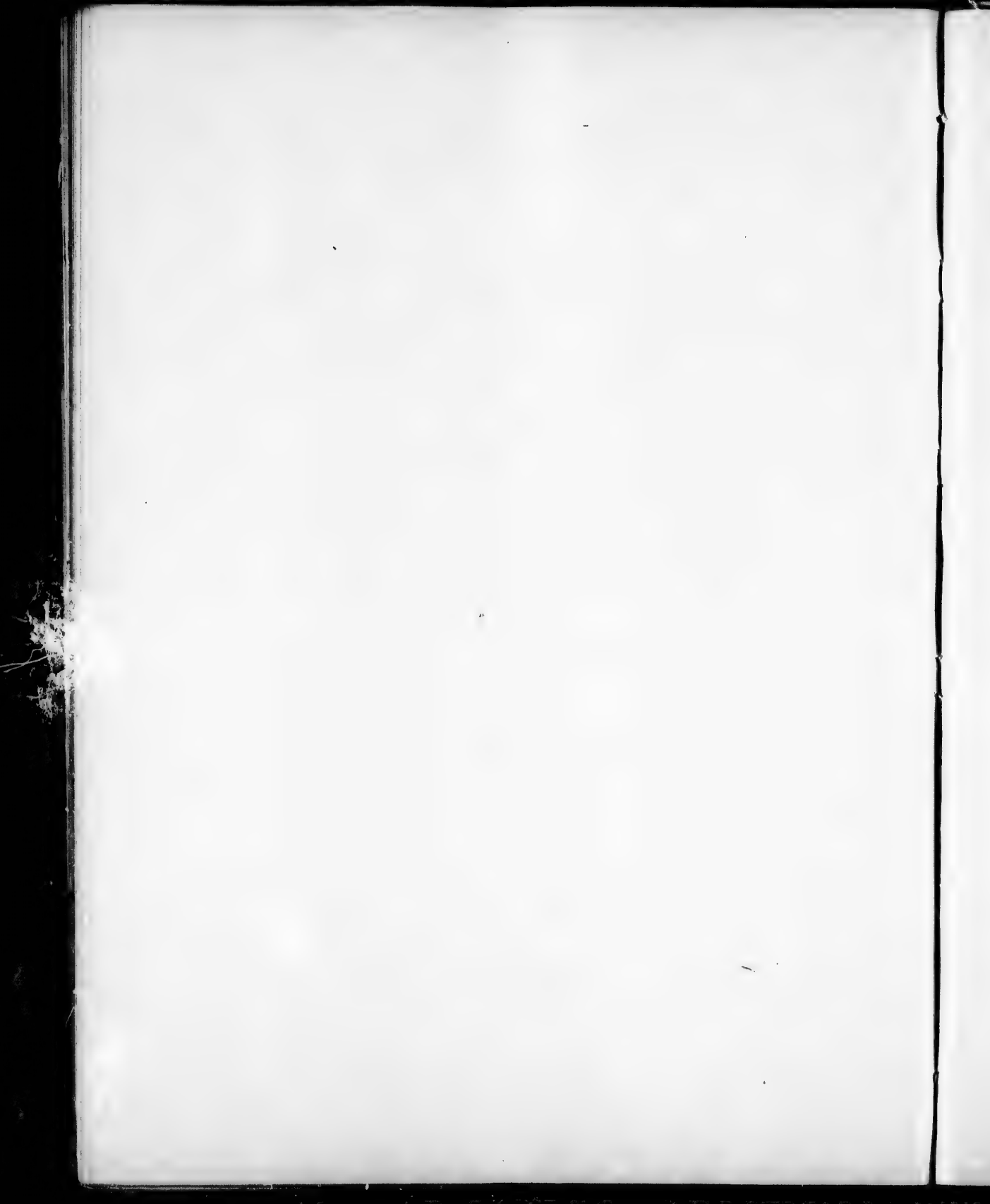


Fig. 17. *Sphenopteris elongata*. 18. *Davallites Richardsoni*. 19. *Adiantites praelongus*.
 20. *Torreyia densifolia*. 21. *Salisburya Baynesiana*. 22. *Phragmites cordaiformis*.



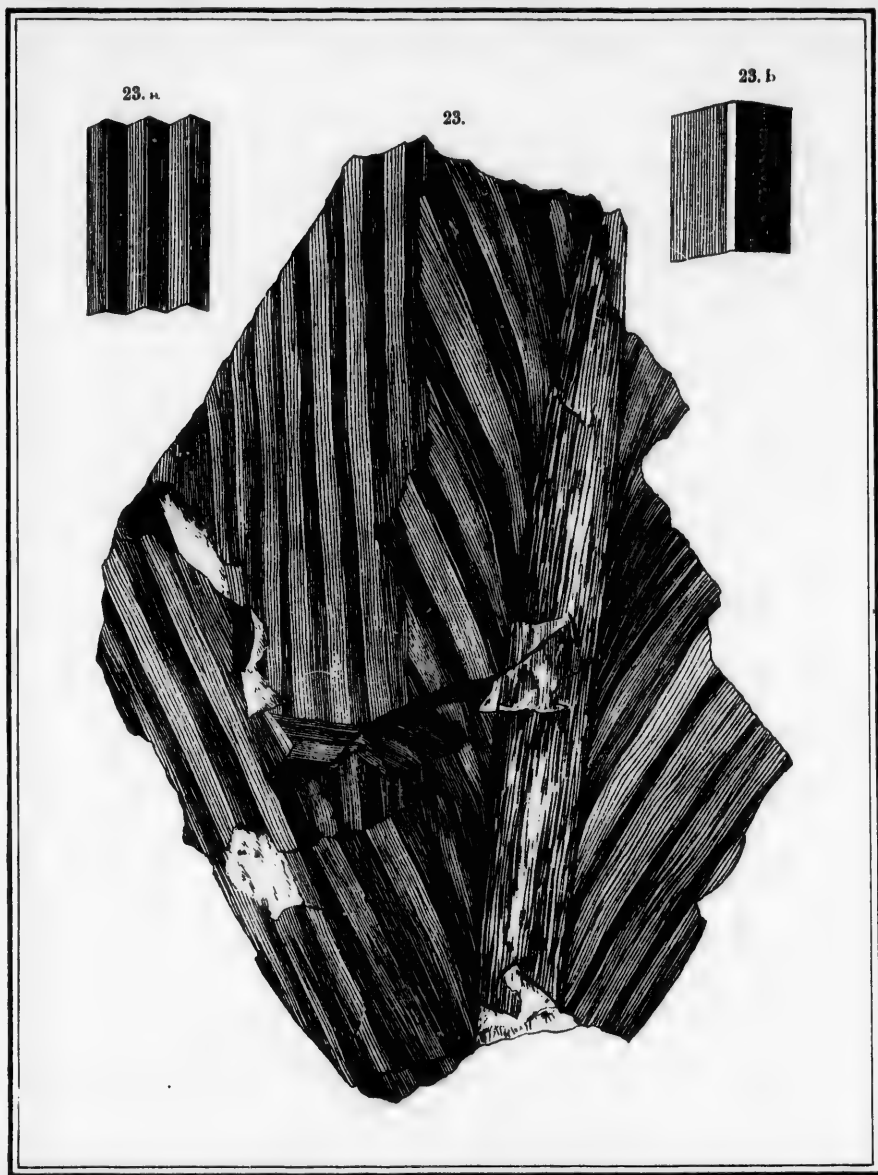
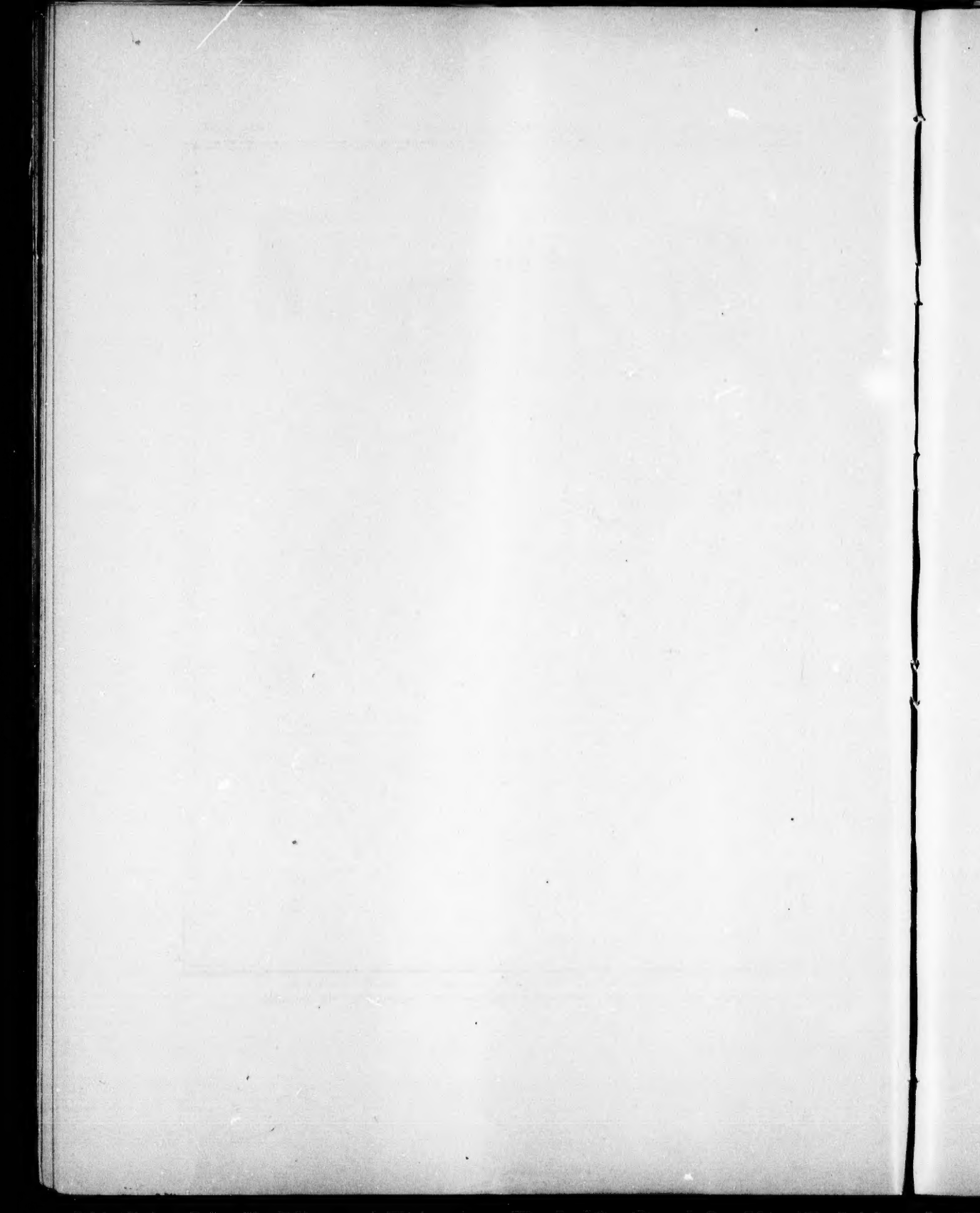


Fig. 23. *Sabal imperialis*.



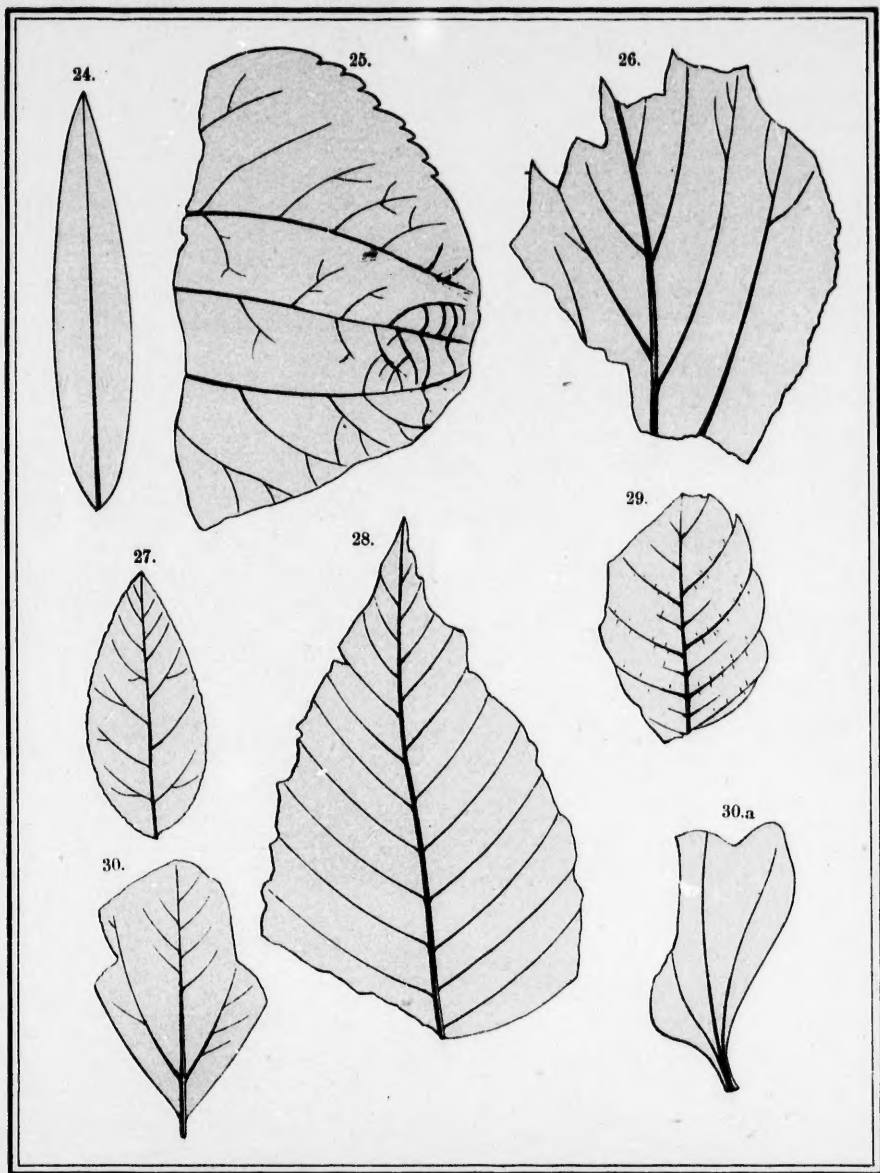
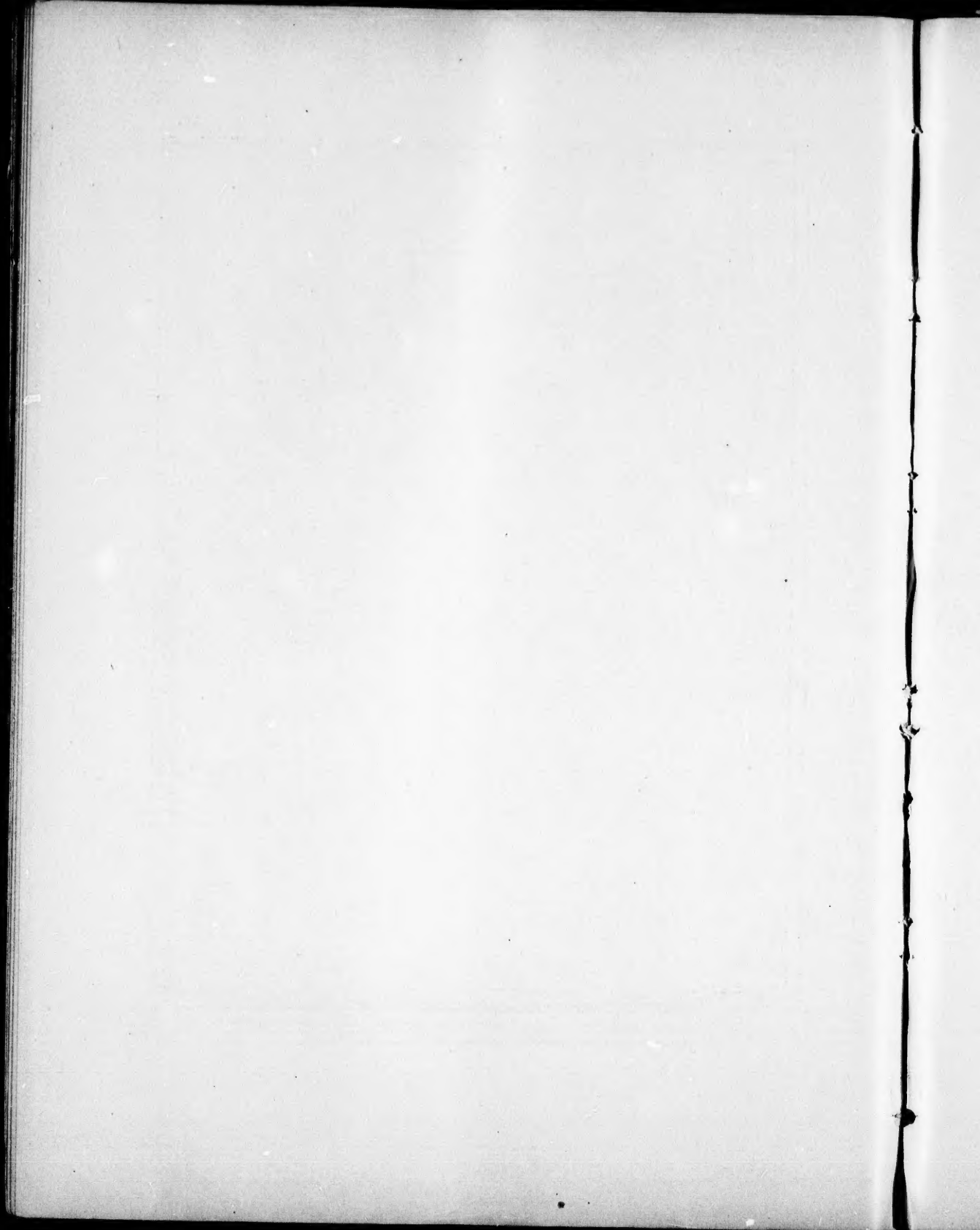


Fig. 24. *Salix Pacifica*. 25. *Populus proto-zadachii*. 26. *P. rectinervata*.
27. *Betula perantiqua*. 28. *Quercus Victoriae*. 29. *Ulmus dubia*. 30. *Sassafras*.



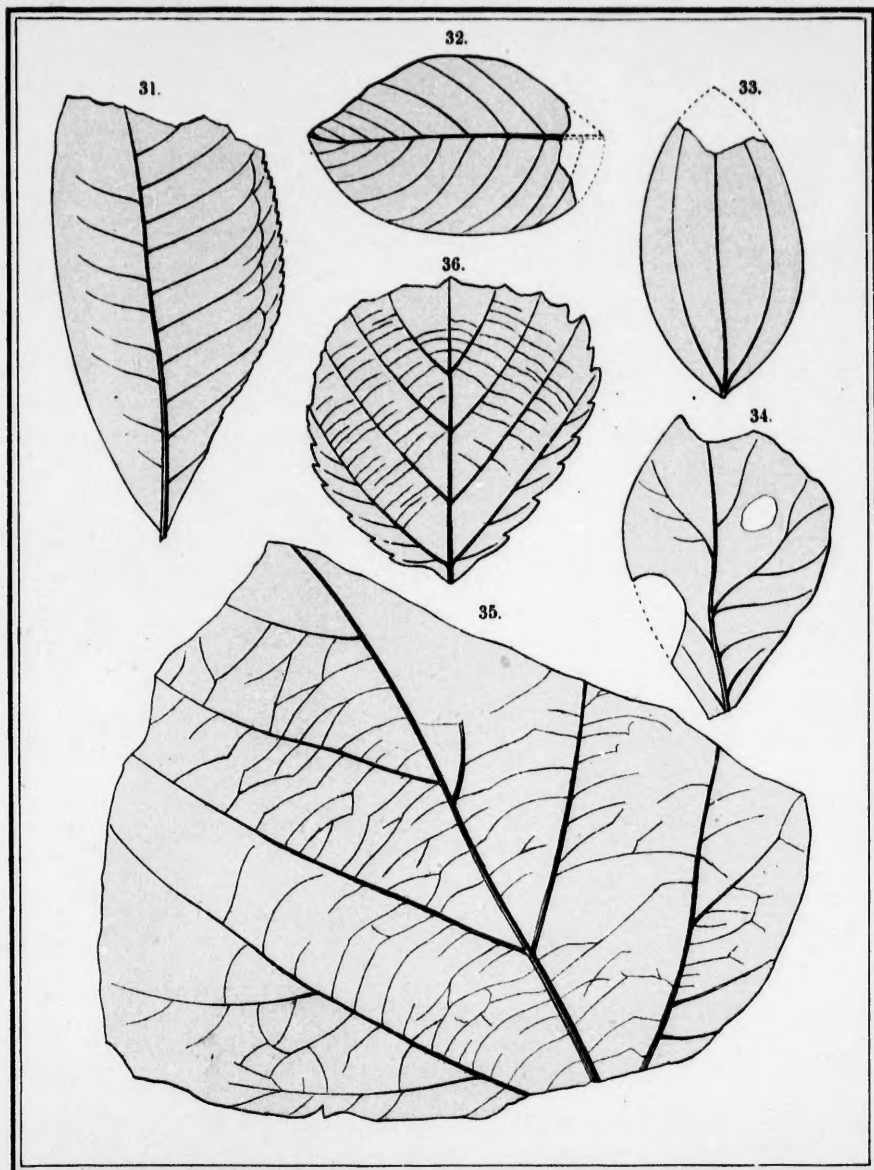


Fig. 31. *Juglans Harwoodensis*. 32. *Diospyros Vancouverensis*. 33. *Ceanothus cretaceus*.
34. *Anisophyllum*. 35. *Protophyllum Nanaimo*. 36. *Alnites insignis*.